MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
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SRM Number: 3145a
MSDS Number: 3145a
SRM Name: Rubidium Standard Solution

Date of Issue: 30 May 2006

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of rubidium. One unit of SRM 3145a consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of rubidium. The solution contains nitric acid at a volume fraction of approximately 1 %.

Material Name: Rubidium Standard Solution

Other Designations:

Rubidium: Ru; elemental rubidium
Rubidium Nitrate: Nitric acid, rubidium salt
Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	1
Rubidium Nitrate	13126-12-0	236-060-1	1.7
Rubidium	7440-17-7	231-126-6	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Rubidium and its compounds may damage the respiratory tract, kidneys, and other organs.

Physical Hazards: Glass container may break or shatter.

Potential Health Effects

Inhalation: Nitric acid can damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Teeth may also be damaged. Symptoms of exposure to either nitric acid or rubidium may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. When ingested or inhaled, rubidium may react with moisture to form rubidium hydroxide, which is highly corrosive. Rubidium nitrate may irritate the upper respiratory tract.

Skin Contact: Nitric acid can cause severe skin burns. Effects of acid burns may be delayed. Contact with rubidium metal may also cause severe burns and ulceration. Rubidium nitrate may cause skin irritation. Allergic skin reaction may occur.

Eye Contact: Nitric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Contact with rubidium may also cause severe burns, ulceration, and possible blindness. Rubidium nitrate is primarily an irritant.

Ingestion: Nitric acid can cause severe burns and damage to the GI tract. Ingestion of rubidium may damage the kidneys or other organs. Animal studies suggest that rubidium may accumulate in muscle and other tissues, and that it may act on the central nervous system as a stimulant. When ingested or inhaled, rubidium may react with moisture to form rubidium hydroxide, which is highly corrosive. Rubidium nitrate may irritate the GI tract; ingestion of large amounts of nitrates in general may cause GI upset, headache, anemia, convulsions, and collapse.

Medical Conditions Aggravated by Exposure: None documented for this mixture. Its components may aggravate disorders of the eyes, skin, respiratory tract, kidneys, central nervous system, and/or blood. Pregnant women should avoid contact with rubidium and its compounds.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate ($NaHCO_2$). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Nitric acid is a powerful oxidizing agent that can react with combustible materials to cause fires. Rubidium nitrate is also an oxidizer that may explode on contact with combustible materials. Solid rubidium (not present in this SRM) may ignite spontaneously in air; contact with water may release flammable hydrogen gas and corrosive rubidium hydroxide. No data are available for the solution, and its behavior may differ from that of the individual components.

Extinguishing Media: Dry chemical, dry salt, or sand. Do not use water or CO_2 when fighting fires involving rubidium. No data are available for the solution, and its behavior may differ from that of the individual components.

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. ACCIDENTAL RELEASE MEASURES

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. HANDLING AND STORAGE

Storage: Store unopened containers of this material in a dry place with acid-resistant flooring at room temperature. Protect from physical damage, water, humidity, heat, direct sunlight, and incompatible materials.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Nitric Acid:

ACGIH TLV-TWA: 2 ppm or 5 mg/m^3
OSHA TLV-TWA: 2 ppm or 5 mg/m^3
UK WEL: 5.2 mg/m^3

Rubidium Nitrate:

OSHA TLV-TWA: None established. Total nuisance dust, 15 mg/m^3; respirable dust, 5 mg/m^3
ACGIH TLV-TWA: None established. Total nuisance dust, 10 mg/m^3; respirable dust, 3 mg/m^3
UK WEL: None established. Total inhalable dust, 10 mg/m^3; respirable dust, 4 mg/m^3

Rubidium:

OSHA TLV-TWA: None established. Total nuisance dust, 15 mg/m^3; respirable dust, 5 mg/m^3
ACGIH TLV-TWA: None established. Total nuisance dust, 10 mg/m^3; respirable dust, 3 mg/m^3
UK WEL: None established. Total inhalable dust, 10 mg/m^3; respirable dust, 4 mg/m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Rubidium Nitrate	Rubidium
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	**Appearance and Odor:** White crystals	**Appearance and Odor:** Silvery-white metal, no odor.
Relative Molecular Weight: 63.02	**Relative Molecular Weight:** 147.47	**Relative Molecular Weight:** 85.47
Molecular Formula: HNO_3	**Molecular Formula:** $RbNO_3$	**Molecular Formula:** Rb
Specific Gravity: 1.054 (10%)	**Specific Gravity:** 3.11 (solid)	**Specific Gravity:** 1.532 (solid)
Solvent Solubility: Decomposes in alcohol	**Solvent Solubility:** Soluble in methanol, ethanol, and acetone; slightly soluble in acids.	**Solvent Solubility:** Soluble in acids; decomposes in alcohol.
Water Solubility: Soluble	**Water Solubility:** Soluble	**Water Solubility:** Reacts violently with water; decomposes
Boiling Point (ºC): 86 (187°F)	**Boiling Point (ºC):** N/A	**Boiling Point (ºC):** 688 (1270ºF)
Vapor Pressure (Pa): 946 @20°C	**Vapor Pressure (Pa):** N/A	**Vapor Pressure (Pa):** N/A
Vapor Density (Air=1): 2.17	**Vapor Density (Air=1):** N/A	**Vapor Density (Air=1):** N/A
pH: 1.0 (0.1M solution)	**pH:** N/A	**pH:** N/A

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this solution do not exist. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

The mixture is stable at normal temperatures and pressure.

Conditions to Avoid: Moisture, air, heat, or incompatible materials.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Rubidium Nitrate: Incompatible with combustible organic materials (may ignite), reducing agents, strong acids, nitrites, cyanides, thiocyanates, isothiocyanates, hypophosphites, phosphinates, tin (II) chloride, phosphorus, alkyl esters, aluminum powder + water,

Rubidium: Incompatible with water, oxygen, mercury, acids, oxidizing agents, alcohol, CO_2, halogens, and halocarbons.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of this material may produce nitrogen oxides, rubidium oxides, hydrogen gas, and other products.

Hazardous Polymerization: ____ Will Occur __X__ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg

Rat, oral: LD_{50} > 90 mg/kg

Rat, inhalation: LC_{50} (4 hrs) = 130 mg/m^3

Rubidium Nitrate:

Rat, oral: LD_{50} = 4625 mg/kg

Rubidium:

Rat, intraperitoneal: LD_{50} = 1200 mg/kg

Target Organ(s): Skin, eyes, respiratory tract, GI tract, central nervous system, blood, kidneys.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has been investigated as a possible mutagen. Rubidium and its compounds have also caused birth defects in animals.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Green shore crab (*Carcinus maenas*): LC_{50} (48 hrs) = 180,000 µg/L
Starfish (*Asterias rubens*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Hooknose (*Agonus cataphractus*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L
Cockle (*Cerastoderma edule*): LC_{50} (48 hrs) = 330,000 to 1,000,000 µg/L

Rubidium Nitrate: No ecotoxicity data found.

Rubidium:

Algal mat (green algae, cyanobacteria, and diatoms): At concentrations of 54.0 to 2000 µg/L, rubidium bioaccumulated in algae and reduced species diversity.

Environmental Summary: The ecological effects of this mixture have not been fully evaluated, but it may be toxic to aquatic organisms. Do not release to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture are a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution, Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lb.
Rubidium Nitrate: Not regulated
Rubidium: Not regulated

SARA Title III Section 302: Nitric acid is regulated

SARA Title III Section 304: Nitric acid is regulated

SARA Title III Section 313: Nitric acid and rubidium nitrate (N511, Nitrate Compounds) are regulated.

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations ($\geq$ 94.5%) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	Yes
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: No components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)
Rubidium Nitrate: C (oxidizing material)
Rubidium: D1A (very toxic material)

WHMIS Ingredient Disclosure List: Nitric acid is regulated.

CEPA Domestic Substances List (DSL): Nitric acid is regulated.

CEPA Non-Domestic Substances List (NDSL): Rubidium and rubidium nitrate are regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)
Rubidium Nitrate: Xi (Irritant), O (Oxidizing); not classified in Annex I of Directive 67/548/EEC.
Rubidium: T (Toxic); not classified in Annex I of Directive 67/548/EEC.

Risk Phrases (mixture):

R23 (toxic by inhalation)
R25 (toxic if swallowed)
R34 (causes burns)
R36/37/38 (irritating to eyes, respiratory system and skin)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)
S28 (wash after contact with skin)
S45 (in case of accident or illness, see doctor; show label)
S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: No components are listed.

16. OTHER INFORMATION

Sources:

[Anon.], New vistas on rubidium. *L'Encéphale* 1977; 3(4):333-56. [In French]

CRC Handbook of Chemistry and Physics. 53rd Edition, 1972-1973.

PAN Pesticide Database: Nitric Acid.

Patrick R, et al, The role of trace elements in management of nuisance growths. Corvallis, OR: U.S. Environmental Protection Agency, EPA 600/2-75-008, 1975.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, September 2005 edition. DHHS (NIOSH) Publication No. 2005-151.